

XI. *Further Observations on the Habits of Monodontomerus; with some Account of a new Acarus (Heteropus ventricosus), a Parasite in the Nests of Anthophora retusa.*  
By GEORGE NEWPORT, Esq., F.R.S., F.L.S. &c.

Read March 5, 1850.

AS some of the details of a paper on "certain *Chalcididae* and *Ichneumonidae*," which I had the honour of communicating to the Linnean Society, in March 1849, drew forth, at that time, the criticism and dissent of some entomologists who had paid considerable attention to those groups, I was desirous, during the past summer, of repeating my observations, and, having the ascertainment of strict truth for my object, sought to correct, if erroneous, whatever might have been questioned, and to confirm by further observations what I had already correctly stated. Accordingly, on the 16th of September last, I revisited the spot at Gravesend, where, two years before, I discovered the larvæ which proved to be those of *Monodontomerus*, and of which an account was given in the paper above referred to.

On this second occasion I had the good fortune to obtain an abundance of these larvæ. Some idea may be formed of the number discovered by the fact that I brought away with me *two hundred and forty-seven* specimens, independent of many that were accidentally lost in the search. These larvæ were found, as on the previous occasion, in the closed cells of *Anthophora retusa*, either in those which still contained the *larva* (TAB. X. fig. 1) or *nymp*h (fig. 2) of that bee, or in others in which the original inmate had been destroyed. The number of larvæ of *Monodontomerus* found in the first five cells opened was *nineteen* in the first; *twenty-three* in the second; *thirteen* in the third; *nineteen* in the fourth, and *thirty-four* in the fifth. In each of these cells I had full proof that the parasites had fed on the *Anthophora* itself, as stated by another observer in correction of my first supposition, and as I had already been convinced by examination of the organs of nutrition. The emptied and dried-up tegument alone was all that remained of the body of the original inhabitant in each cell. In order however that there should be no mistake on this fact, I removed three of the cells, which contained larvæ of *Monodontomeri*, without opening them further than to ascertain the presence of the parasites, and placed each in a separate small box to examine the contents at leisure, and more accurately than I could do on the spot. This examination was made on the following day, and each cell was then found to contain the dried-up remains of a single larva of *Anthophora*, with a variable number of the larvæ of *Monodontomerus*,—*nineteen* in the first cell, *twenty-three* in the second, and *thirteen* in the third as just stated. In neither of these instances had the parasites been contained or fed within the body of the bee-larva, but had exhausted it from without, and had drained the body of its contents in the same way as the larva of *Paniscus* drains that of the body of the caterpillar. In those cells in which the parasites were of largest size, the remains of the bee-larvæ had been most completely exhausted; while in two of the cells the tegument was still soft, and not quite emptied, but in each

instance it was shrivelled up and lay at the larger end of the cell. In a fourth cell, which I took home with me almost entire, there were eighteen larvæ of *Monodontomerus*, and the remains of a nymph of *Anthophora*. In this cell the parasites were scarcely more than one-half grown, and the remains of the nymph were very complete. The head, limbs, and parts of the mouth were still uninjured, but the thorax and abdomen were nearly emptied. The parasites had pierced the body in both these regions, and were ranged on each side of it. This specimen therefore confirmed Mr. Smith's statement\*, that the *Monodontomeri* feed on the nymph of the bee, as I had previously shown that they feed on the larva. It also afforded the fullest confirmation of my original opinion,—that these parasites are *external feeders*,—a view to which I was led,—*not*, as erroneously stated by Mr. Westwood, in the printed Proceedings of the Society†, from the simple fact of my having found that the bodies of these parasites have an armature of hairs; *but*, as explicitly stated in my paper‡, as read to this Society, because I have never yet found hairs on the bodies of internal feeding parasites. External feeders, nevertheless, may be deficient of this armature, as in the instance of *Eulophus Nemati* cited by this observer.

As the whole of the tegumentary portion of the body of the nymph of *Anthophora*, obtained by myself, like that of the larva, remained in the cell, although partially shrivelled up, there seems to have been some error also, in part of Mr. Smith's observations, as given in the following words§: "When first observed the pupa of the bee was about one-third consumed, and at last *not a vestige of it remained*; all that the cell contained, besides the larvæ, being a small portion of yellow dust, or small granules." I cannot help regarding this statement as having originated in oversight or mistake, as in every cell which I have examined the tegumentary remains of the destroyed bee-larva have invariably been present; while in neither of the many cells which I opened very carefully at the moment of finding them in their natural haunts, nor in the four which I preserved for still closer examination at home, could I detect any "yellow dust or granules." There were only the parasites and the more or less dried-up tegumentary remains of the destroyed insect. Neither was there any "yellow dust or granules" in the cell with the nymph of *Anthophora*. All which this contained were the parasites and the remains of the nymph; together with the larva skin it had thrown off on assuming this condition; while the larger end of the cell was coated with a perfectly smooth layer of *ejecta*; a coating which, as I formerly stated, it always gains after the larva has ceased to feed, and before it changes to a nymph. I mention these circumstances the more particularly, because, as Mr. Smith's remarks on *Monodontomerus* were communicated to the Linnean Society in correction of mine on this insect, previously read, and as the abstract of that paper has since been published in the "Proceedings," it is incumbent on me to notice his statements with care, and to show in what we agree or differ. In his communication to the Society, he states that he obtained the larvæ of this insect "in the summer of 1848||," and also remarks:—"I then made a drawing of the larva of the parasite, which I enclose." On this drawing is written the following confirmatory note:—"Larva found feeding on the pupa of *Anthophora retusa*, July 1848." The following

\* Proceedings, vol. ii. p. 29, April 3, 1849.

† May 1, 1849, vol. ii. p. 37.

‡ Transactions, vol. xxi. p. 67.

§ Proceedings, vol. ii. p. 29, April 3, 1849.

|| *Loc. cit.* p. 29; also Ann. and Mag. Nat. Hist. August 1849, p. 124.



passage from the Proceedings of the Entomological Society\*, printed in 1848, records the exhibition, by myself, at that time, of specimens of the *Imago* insect, reared from the larvæ mentioned at p. 67, found on the 12th of September, 1847:—"July 3rd, 1848. Mr. Newport exhibited a new species of the genus *Monodontomerus*, belonging to the family of the *Chalcididæ*, reared from larvæ which he had found in the nests of *Anthophora retusa*. He proposed for it the name of *M. nitidus*."

Thus my recent observations on *Monodontomerus* in its natural haunts, supported by further examination of the anatomy of its digestive organs (figs. 3 & 4), have fully confirmed my former opinions as regards the nature of the larva, that it is an *external* and not an *internal* feeding parasite, and that some remains of the destroyed bee-larva are always found in the cell. They confirm too the observation that the bee-nymph is preyed upon; as well as that the larva of *Monodontomerus* is carnivorous; but they do not support the statement, and the inference to be deduced from it, that "not a vestige" of the bee is left in the cell. Further, they give strength to the opinion I have advanced respecting the mode and time of introduction of the eggs of the parasite; viz. by perforation of the cell. The circumstance of the bee-nymph being preyed upon, as well as the larva, goes far to establish this, as in each instance the parasites with the nymph were scarcely more than one-half grown. This seems to show that they had been introduced at the time of change, or at a very late period of the larva state. There seems reason to believe also that the eggs are seldom conveyed into the cell until long after this has been closed, and consequently when the bee-larva within has far advanced in growth, as in no one instance could I discover a particle of the food of the larva.

Being desirous, however, of ascertaining facts by direct observation, rather than of arriving at views by inference, I placed, on the 17th of September, twenty of the most healthy middle-sized specimens of the larval *Monodontomeri* with a single larva of *Anthophora*, in one division of a glass tube; and twenty smaller specimens, with a nymph of this bee, in another division of the same tube, separating the two sets with a piece of sponge, and closing the tube with a cork. On the following day the parasites had arranged themselves with their heads towards the body of the larva, but they did not appear to have commenced their attack, probably from a cause which I shall presently mention. On the next day, however, the third of inclusion in the tube, I saw one individual attack the nymph, and in precisely the same way in which the larva of *Paniscus* attacks the caterpillar, by piercing the skin, and imbibing the fluid as it transudes. On the 22nd of September, the fifth day of inclusion, I was surprised to find that some of the specimens were changing colour, and looking unhealthy, and that not one of them appeared to be feeding. On the following day the whole were slightly discoloured; and, on very close inspection, I then first noticed that their bodies were covered with multitudes of little spherical bladder-like objects, exactly similar, at first view, to microscopic drops of fluid transuded through punctures in the skin. My hope to follow out a series of observations on these larvæ was now at an end, as it was evident to me that they were diseased and perishing. But I was entirely at a loss to imagine the cause of this failure, as at the time the specimens were collected, the whole were perfectly healthy and strong. On the 24th September they were

\* Trans. Entomological Society, vol. v. part 5, 1848, p. 42.

still further discoloured, and many of them were dead, and all were covered with the bladder-like bodies in greater abundance.

On examining other specimens of these larvæ, which I had placed in separate bee-cells, I found that these also were in a similar condition; and on inspecting my collection of larvæ and pupæ of *Anthophora*, these too, to my utter astonishment, were covered in the same manner. I noticed also that the vesicles first observed on the larvæ in the glass tube had become much larger, during the past two days; and on inspecting them very carefully with a lens, I found that the bladder-like bodies were either the nidi of parasites, or living parasites themselves attacking and exhausting the enemies of the young bee, as the bee had been attacked by them (fig. 5). Thus in less than eight days from the time when my specimens were collected, the whole were irretrievably destroyed by objects which now covered them in multitudes, but which at first were so microscopic as entirely to escape observation. As it was now evident that my whole collection of larvæ of *Monodontomeri* would soon entirely disappear, I placed a number of them, together with the parasites that covered them, in spirit for future examination. Out of nearly two hundred and fifty specimens of these, and of a still greater number of larvæ and nymphs of *Anthophora*, the result of the persevering labour of several hours' search, I was not able to save even a single specimen. Wherever I placed them in the room appropriated to my investigations, they became covered with these microscopic enemies, whether secured in wooden or tin boxes, or covered earthen pots. I now began to suspect the cause of this mischief. During the time I was collecting the larvæ, on the 16th of the month, I found some bee-cells nearly filled with a large mass of vesicle-like bodies. These were completely new to me. The body of the bee-larva seemed to have been changed into this mass of spherical nondescripts (fig. 1), which, although quite distinct from each other, were aggregated together, and somewhat resembled a microscopic bunch of grapes. Each of the bodies was opaque and clouded on its upper surface, and seemed to include other bodies. On its under surface it was clear and transparent. They varied greatly in size, from that of a minute pin's head to nearly one-sixteenth of an inch in diameter. Having found several of the cells filled with them, I collected these cells, for the purpose of ascertaining, if possible, the nature of their contents. I found also one cell in which these bodies, as well as the remains of the bee-larva, were almost dried up. The instant this cell was opened and exposed to light, I noticed, on examining the interior with a lens, that it was partly filled with what looked at first like dust; but more closely observed this was seen to consist of crowds of little brown objects (fig. 6), in a state of the most vivid and incessant motion. These were so exceedingly minute that I could only recognise them to be living creatures by means of the lens, and even then with difficulty, without being able to distinguish their form, as they were of the same colour as the clay-soil of the nest. They reminded me very forcibly, by the vivacity of their movements on exposure to light, of the larvæ of *Meloë*, although scarcely one-third the size of those diminutive creatures when first hatched.

No Pandora's box could ever have been more fatal to man, than this bee-cell and its contents became to my store of larvæ. I placed it together with those which seemed to contain only vesicles in the same case, which I did not again examine until the following day, and then found, to my surprise, that but very few of the dust-like objects remained in



the cell. The majority, as was afterwards proved by what I have just stated, had crept out and distributed themselves over the room. Many probably had escaped into my other collecting boxes while being conveyed home.

It was in the afternoon of the following day that I placed my larvæ of *Monodontomerus* with that of the bee, in the closed glass tube, as already mentioned; so that, in all probability, it was during the few hours that my boxes which contained the young bees and their parasites remained near that which enclosed the cell, that these little creatures escaped and affixed themselves to the larvæ. This was at a stage of existence when the whole brood of nondescripts had been recently matured, and probably soon after there had been communion of their sexes (?) within the cells,—if, indeed, males, which I have not been able to identify, are produced,—and before the bodies of the fertilized females, which the vesicles in the other cells, as well as those afterwards found on my larvæ, all proved to be, had begun to be enlarged. These diminutive objects I soon found to be *Acari* of a new type (fig. 7).

I have said that the bladder-like bodies were fertilized females. There seems to be full proof of this in the following circumstances. At the time when I enclosed the larval *Monodontomeri* in the glass tube, the temperature of the atmosphere of the room was above 55° Fahr., and very frequently during the ensuing fortnight was more than 60° Fahr. The growth of the *Acari* was then very rapid. Within ten days from the time when they affixed themselves, indeed within eight from my first observing them, the bodies of some were enlarged to the size of the head of a small pin, and the ova within them were readily and distinctly identified with the microscope. They increased in bulk most rapidly during the first fortnight, after which their enlargement was less perceptible. On the contrary, I fancied, but was not certain, that they became somewhat smaller. Several of them at first were more opaque, and afterwards became of a brownish colour. In about three weeks, during which time the tube had been frequently exposed to the sun, there was full proof that some of these specimens had produced young. The interior of one end of the tube was then covered with a great number of *Acari*, such as I had originally seen in the bees' nest (fig. 6); not with the abdominal portion of their bodies enlarged, but short, narrow, and somewhat tapering at its extremity. These little beings appeared to have only recently come forth, as they were of a much lighter colour, and somewhat smaller than those which were found in the cell. Some of them placed on a micrometer plate measured only sixteen thousandths of an inch in length. The glass tube being tightly stoppered with a cork, so that nothing could enter or escape, it was fair to conclude that these were the young of some of the females attached to the bodies of the larvæ, although I neither saw them come from their parents, nor was able to find that any ova had been deposited from which they might have been hatched. Nevertheless they had already undergone the change common to the tribe,—that of obtaining an additional pair of legs, as they had the full complement—four pairs. It is well known that this is not the condition in which *Acari* are usually produced, each having at first but three pairs. It remains for future inquiry, therefore, to show in what condition this species first makes its appearance,—whether ova are at any time deposited and afterwards become hatched, whether ova are produced at one season and living young at another, or whether, as I have most reason to conclude, the

species is viviparous. The females, already fertile when they quit the cell, move at first with great celerity, the abdomen being then the smallest portion of the body. But as soon as they have penetrated into other bee-nests, and affixed themselves to the bodies of the inmates, and begun to drain them of their fluids, the posterior three or four segments of the bodies of the little nondescripts become rapidly more and more enlarged, and assume the spherical bladder-like appearance seen on the bee-larva or its parasite. This enlargement is carried to such an extent, that this portion of the body of the gravid *Acarus* soon becomes at least ten, or twenty, or even more times its original size, and at first sight seems alone to constitute the entire being (fig. 8). The *Acarus* in the meantime loses its power of locomotion, and becomes affixed to one spot, or changes its place so little, and so imperceptibly, as to appear to be immoveable. Gorged with the nutriment imbibed, it sinks into a state of almost vegetative existence, and seems to lose all the energy and power of motion it originally possessed; strongly reminding us of a similar degradation of animal function which the active little *Meloë* undergoes before it attains its full growth as a larva; and which the *Stylops* also passes through, before it is re-developed in the one sex as one of the most lively of beings, or diverges still further in the other, from the usual condition of an animal, as a mere nidus for the production of new existences. This approach to the vegetative type is the form in which these pregnant *Acari* are found in the bees' nest, crowding over, and hiding the remains of the larva they have destroyed. From all which I have as yet been able to observe, these *Acari* appear to become nidi for the development of the eggs formed within them; and I have much reason to believe that, as in *Stylops*, the young pass through their earlier stages within the bodies of their parents, and escape from them in an active condition, possibly at first as hexapods. The common cheese mite, according to Lyonnet, produces living young at some temperatures, and ova at other more reduced ones; and this, as we know, is the case with the whole tribe of *Aphides* among insects. Whether the female *Acari* perish before their young are hatched, or whether, as I believe, the birth of these is the immediate prelude to their parents' death, I have not yet ascertained. It is certain, however, that the largest-sized females become discoloured earlier than the smaller, and this too I believe in proportion to the temperature of the season. The temperature of the season, or of the locality in which the *Acari* are placed, greatly influences, not only the more or less rapid enlargement of the bodies of the females themselves, but, as I believe, the hatching of the ova within them. This has been proved to me by the fact that a very large proportion of the females, with the abdomen of full size, early in the autumn, but when the temperature of the season was gradually subsiding,—and which I was careful not to expose to the sun,—have remained alive during the winter to the present time, a period of five months, without producing young, or, so far as I can discover, depositing any eggs. In some of these specimens which I examined a few days ago, I found the ova still immature, and even the germinal vesicles within them still present, and easily detected. We may conclude, therefore, that a rather high temperature is required to complete the development of the ova and produce the embryo. This high temperature is always found during summer in the natural haunts of the *Anthophora*. The clay banks, in which these insects construct their cells become heated by exposure to the morning and



mid-day sun, sometimes to as much as  $84^{\circ}$  Fahr. at a depth of one inch and a half, as I have elsewhere shown\*, and much of this heat is retained throughout the whole twenty-four hours; so that, in all probability, the growth of the pregnant *Acari*, and the hatching of their ova, then proceed very rapidly; while, on the contrary, these, as well as the changes of the bee-larvæ, are entirely arrested during winter. This will explain, what might otherwise seem to be discrepant, that some young *Acari* were produced after exposure to the sun, and in a warm room in October, while others not exposed to the sun, and the season becoming colder, have remained until the present time undeveloped.

Having stated thus much respecting the economy of this microscopical parasite, I will now endeavour to describe it, and to show that it constitutes a new genus of its class. It belongs to the section *Tyroglyphus* of Latreille and Gervais, the tribe *Sarcoptides* of Koch, which has the *Sarcoptes scabiei* of the human subject as its type, and which includes also the *Demodex folliculorum* of Simon and Owen, a parasite in the follicles of the hairs in Man. It is most nearly allied to Koch's genus *Dermaleichus*, most of the species of which are parasites on birds; but it is perfectly distinct from that, as well as from the genus *Trichodactylus* of Dufour, a parasite on the Mason-bees of the genus *Osmia*. It is equally distinct from the *Ansetus* of Dujardin, which also is a parasite on bees, although it approaches these two genera in certain particulars. It resembles the latter in the general elongated form of body and in the size of the haunches of the legs; but it differs in the body being articulated throughout, in having a somewhat cordiform moveable head, the prothorax distinct from the trunk and abdomen, and the anterior pair of legs palpiform, while the three posterior pairs are equal, and terminated by four-jointed slender tarsi, the last joint in each being cordiform and pad-like, as in the larva of *Stylops*. In this latter respect it has affinity with the genus *Hypopus* of Dugès, as it has also with *Trichodactylus* in the legs being covered with a few very long hairs.

With regard to the change and enlargement of the body in the female sex of the *Acarus*, every one will remember that its parallels are to be found amongst true hexapods, in the *Termites* and the *Pulex penetrans*.

The characters I would assign for the new *Acarus* are:—

#### Class ACARI.

Fam. SARCOPTIDES, Koch.

Gen. HETEROPUS, Newp.

*Corpus* elongatum, subarticulatum. *Caput* mobile. *Thorax* a trunco distinctus, ad latera corpusculis clavatis munitus. *Pedes anteriores* palpiformes; *reliqui* (parium trium posteriorum) æquales, arcuati, attenuati, tarsis gracilibus 4-articulatis, articulo terminali lato vesiculari.

H. VENTRICOSUS (figs. 6, 7 & 8), pallidè ferrugineus, capite saturatiore, prothorace paribus 2 pilorum longorum, pedibus subrobustis; articulis omnibus longè pilosis: tibiæ articulo apicali corporis dimidium æquante.—Long.  $\frac{1}{6}$ — $\frac{1}{8}$  lin.

♀ gravidæ abdomine magnoperè inflato vesiculari.

*Hab.* in nidis *Anthophoræ retusæ*, apud Gravesend, in comitatu Kent, mense Sept. 1849.

\* Phil. Trans. 1837, p. 279.

The importance of a thorough examination of these microscopic pests is at once evident, in the fact that the type of the family to which the whole of them belong is the noisome parasite of the human subject; that another, as yet undetermined form of the same tribe, is thought by some to be connected with one of the most fatal ailments of our frame, dysentery; that two distinct *Sarcoptes* yet undescribed affect the horse and sheep; and that even the common sparrow, and our little pet the canary, are infested by others of this class.

When, therefore, we reflect on the ailments which these produce, and on the diminutive size of the creature I have just characterized, and which in its effects are so destructive to other tribes, and bear in mind that this mere speck, this particle of dust, is organized for all its purposes as completely as the most perfect of any of the whole sub-kingdom to which it belongs,—even to the flexor, the extensor, and the rotator muscles of its truly atomic limbs (fig. 9) and tarsi,—while the entire body of the creature, when first produced, measures scarcely more than sixteen thousandths of an inch in length;—and then call to mind that the mere foot alone of the *Dinornis*, or of the *Palapteryx*, the ancient colossal birds of the Antipodes, measures, as shown by the most renowned anatomist of our age, Professor Owen, more than twelve inches—nearly seven hundred and fifty times the whole size of this little body:—who can but feel astonished at this range of Creation?—who can but feel that the study of natural history,—not as the amusement of an hour, but as a sober contemplation,—must tend to exalt as well as to expand the human intellect; and that the most microscopic atom of organized life, considered as part of the world, is as deserving of our fullest attention as the most gigantic?

---

## DESCRIPTION OF THE PLATE.

### TAB. X.

- Fig. 1. A cell containing the larva of *Anthophora* attacked by larvæ of *Monodontomerus*. (a) natural size; (b) magnified two diameters.
- Fig. 2. A cell containing the nymph of *Anthophora* attacked by the parasites:—magnified.
- Fig. 3. Further details of the anatomy of *Monodontomerus*. Digestive system of the larva. (a) salivary organs; (b) section of the œsophagus, (c) of the stomach, and (d) of the pylorus; (e) the Malpighian vessels.
- Fig. 4. Digestive system of the nymph. (a, b, c & d) œsophagus and stomach, as above; (e) Malpighian vessels, exhibiting their cellæform structure and mode of termination.
- Fig. 5. Larva of *Monodontomerus* attacked by parasitic *Acar*i. (a) natural size; (b) magnified three diameters.
- Fig. 6. Newly developed adult *Acarus*, *Heteropus ventricosus*:—magnified.
- Fig. 7. Pregnant female *Heteropus ventricosus* during the development of her ova:—magnified.
- Fig. 8. Several fully developed *Acar*i attached to part of the proboscis of the nymph of *Anthophora*.
- Fig. 9. Posterior leg of the *Acarus*:—magnified.
- Fig. 10. Magnified view of the head of the male *Anthophorabia fasciata*, Newp., as seen by transmitted light, exhibiting the structure of the antennæ (a), showing the flexor (1) and extensor (2) muscles, and (3) the cellæform structure in the cavity of the basilar joint; (b) the lateral, and (c) the vertical ocelli; (d) the brain; (e) the labrum; (f) the mandibles.